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Infographic Material as Supplementary Learning Tool in Advancing Scientific Knowledge of Modular Distance Learners

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Abstract

The study utilized descriptive-developmental research design through the use of integrated, adapted, and expert-validated survey questionnaires, pretest and posttest to find the effects of self-designed problem-based infographic material as supplementary learning tool in advancing the scientific knowledge of thirty (30) Grade 7 students in a public high school in San Pablo City. Modular distance learning related factors and the preferred multimedia resources of the respondents were obtained. Results showed that the problem-based learning stages – problem comprehension, curriculum exploring, and problem solving, and the infographic design elements – visual, content, and knowledge elements, were highly integrated in the developed infographic material. As to the overall acceptability of the problem-based infographic material, intellectual, life skills, and affective development were perceived to be acceptable. Scores of the respondents as to the scientific knowledge – content knowledge, procedural knowledge, and epistemic knowledge, were found to have increased after utilizing the material. Statistical tests of difference also reflected significantly on the scientific knowledge of the learners implying that the use of problem-based infographic material has improved the skills of the learners while no significant relationship to the intellectual, life skills, and affective development. This concludes that the acceptability of the problem-based infographic material partially affects the scientific knowledge of the students.

Keywords: *Problem-based learning, Infographic, Scientific knowledge, Modular distance learning*

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1. Introduction

A billion and a half pupils in 188 countries/economies is unable to attend school in 2020 due to the pandemic (OECD, 2021). Students across the world have experienced schools that are open one day and closed the next, creating significant interruption in their education. Many education systems are currently struggling as the pandemic continues, and the situation is continuously changing. As the Philippines struggled with the impact on communities (Simbulan, 2020), the education sector had to conform to the new scenario, which prohibits face-to-face interaction and mass meetings.

Various distance learning modalities were adapted like online distance learning, blended learning, and modular distance learning to cope with various needs of every student in the Philippines. Due to these changes, students have difficulty in expressing their scientific abilities and skills through the learning materials distributed to them, and the addition of learner's task sheets submitted weekly. For instance, the Mean Percentage Score (MPS) in Science of Grade 7 students of San Vicente Integrated High School obtained during pre-pandemic period were 64.08% for S.Y. 2017-2018, 67.22% for S.Y. 2018-2019, and 75.89% for S.Y. 2019-2020. However, for S.Y. 2020-2021 the MPS of Grade 7 Science dropped to 68.75%. This was obtained at the height of pandemic where distance learning is implemented.

To address this issue, countless reminders, constant monitoring of the advisers and subject teachers through phone calls, text messages, chats, were administered but still the response of some learners and even their parents have been minimal and the results of their scores were poor. It is in this premise that this study devised a way to deliver instructions to learners in the modular distance learning modality through comprehensive and contextual real-life scenarios simplified in a form of infographic.

From the study of Siricharoen and Siricharoen (2015), infographics were employed to support data visualization when there was little time and too much information to understand. Since science education focuses on improving students' scientific literacy, preparing them to be rational and active citizens capable of making decisions and judgements about the application of scientific knowledge that may have health, environmental, or societal consequences (Basco, 2020) is necessary. In this way, students' performance may be further developed by utilizing creative materials like infographics. Hence, this study evaluated the developed infographic material.

2. Literature review

2.1 Problem-based Learning

Problem-based learning (PBL) is founded on a Constructivist Approach and hence encourages active learning. Students participate in activities in groups, usually in a tutorial or seminar setting. Self-directed learning, effective problem solving, communication, and cooperation abilities are all cultivated through PBL (Edith Cowan University, n.d.). According to Overton (2016), PBL can be considered subcategory of context-based learning. It presents real-life contexts in a form of problem scenarios. The fact that the issues or scenarios are met before all of the essential learning has taken place and function as the catalyst for fresh learning is a key element of PBL. As a result, it differs from problem solving, in which challenges are typically faced after learning has occurred. Moreover, it has a very well-defined framework that must be adhered to in order for it to be effective. This method can be altered for any subject and grade level, but to complete a PBL experience, the steps must be done in order.

In the PBL approach, the problem is provided first than teaching relevant content so that students apply their knowledge to solve challenges. The PBL assignments can be simple or complex, and might last a whole semester. Any school topic, from social studies and literature to mathematics and science, can benefit from PBL. An effective PBL strategy should include qualities such that students are challenged to understand things in the classroom on a deeper level. Students are being pushed to make judgments that they can defend connecting current course objectives to past courses and expertise in a clear and concise manner. As the students work together to solve the challenging problem, they engaged in a multi-stage process to answer an open-ended challenge.

Silva (2018) found PBL teaching technique as beneficial to student learning because it encourages the integration of theory and practice, which increases motivation to learn. This is supported by Chamsai and Chanchusakun (2020) providing evidence that students' learning achievements were higher after PBL with infographics than before problem-based learning without infographics. The mathematical abilities of the students have increased after utilizing infographics.

2.2 Infographics

Infographics are visual representations of data in a condensed space and an artistic fashion. They are able to convey information swiftly that keep readers interested in what they are reading. They provide crucial data and information while being fun to read and comprehend (Siricharoen & Siricharoen, 2015). According to Siricharoen and Vinh (2016), infographic is a visual representation of information, facts, or expertise that can be created using a variety of software; some are easier to use than others. A variety of websites can be used to visualize data.

In recent years, infographics have become increasingly popular as a means of visually presenting data. It is a style of visualization that tries to provide any content with a visual composition for the target audience, mixing components such as shapes, symbols, images, photographs, illustrations, and words (Ozdamli & Ozdal, 2017). In teaching and learning, educators can use professional insights to teach students about the characteristics of good infographics (Gallicano et al., 2014). Overall characteristics of simplicity, visual storytelling, accurate and ethical data presentation (by not glossing over contextual factors that can influence the audience's conclusions), source citation, and the application of design principles are all features of a good infographic.

In light of the purposes and benefits of infographics as well as the characteristics of today's students, Alrwele (2017) believes that infographics can be used to help students understand the information presented in a particular course, and that it would be worthwhile to investigate students' perceptions of infographics as a teaching and learning tool. The cores of infographics include visual elements, content elements, and knowledge. Relevant to this, Siricharoen and Vinh (2016) constructed an infographic evaluation-questions matrix according to dimensions of evaluation such ash data, sources, story and flow, design style, color and size, icons, diagrams and charts, words, and publisher. These dimensions of evaluation were classified into the three foundation of infographics which are visual and content elements, and knowledge.

Basco (2020) found that infographics were significant in terms of improving academic performance in Science among learners. Infographics paradigm was created to better comprehend the potential of infographics in the teaching and learning process. This includes the aspect in a learner to be developed in terms of life skills development, intellectual development, affective development.

2.3 Scientific Knowledge

Scientific literacy refers to a person's ability to ask, find, or determine answers to inquiries regarding everyday experiences that arise from curiosity. For Jufrida (2019), scientific literacy is the capacity that pupils must possess in order to understand science, analyze and apply scientific concepts to real-world problems. It is critical for students to understand what they study in school and has a significant impact on their cognitive capacities.

The Organization for Economic Cooperation and Development (OECD) through the Programme for International Student Assessment (PISA) organizes international studies on learners' science literacy skills. In this context, scientific literacy is regarded as a critical component of education for all students, regardless of whether or not they intend to pursue science further (Turiman et al., 2012; OECD, 2013). Based on the PISA Assessment and Analytical Framework (2018), the term "scientific literacy" refers to both a state of mind and a body of knowledge of science and technology. Science and technology, on the other hand, have different aims, techniques, and products. Technology looks for the best solution to a human problem, and there may be multiple best solutions. Science, on the other hand, seeks the truth. a response to a specific question regarding the natural material world. Gormally (2012) classified scientific literacy into categories such as understanding methods of inquiry that lead to scientific knowledge, and organizing, analyzing, and interpreting quantitative data and scientific information. These categories have been subdivided into various skills which were used to test the scientific literacy of their respondents.

According to Siarova (2019), scientific literacy goes beyond the mere knowledge of scientific content. It should be understood as the ability to engage critically with and make informed decisions about science-related issues. This broader approach to scientific literacy should be coherently integrated in curricula. Critical thinking and active engagement should be emphasized as important learning outcomes along with fundamental literacy, scientific knowledge and competences and a contextual understanding of science.

Research highlights the need to integrate various elements of scientific literacy across educational levels and subject areas (such as science, history, geography, citizenship, health, and media education). Fostering scientific literacy requires an integrated approach involving investment in, and re-thinking of, both formal and non-formal education. Measuring scientific literacy comprehensively proves to be a challenge. Existing tools are often focused on students' level of scientific knowledge and competences, leaving aside such elements as critical thinking and active engagement. The development of comprehensive assessment instruments could allow grasping scientific literacy more holistically and better understanding what educational approaches can help develop it.

2.4 Theoretical Framework

This study is anchored on Cognitive Theory on Multimedia Learning (Mayer, 2014). This theory specifies five cognitive processes: selecting relevant words from the presented text or narration, selecting relevant images from the presented graphics, organizing the selected words into a coherent verbal representation, organizing selected images into a coherent pictorial representation, and integrating the pictorial and verbal representations and prior knowledge.

For Quarter 3 of Science 7, it discusses Force and Motion, specifically on the topics of Sound, Light, and Heat (K to 12 Curriculum Guide for Science, 2016). These competencies were used for the PBL Integration which according to the National Education Ministry of Indonesia as cited by Wicaksono (2019) has been found to be capable of developing science process skills of the learners as a strategy in face to face learning.

The multimedia preferences of the learners were considered in the development of an instructional material based on the findings of Gueta and Janer (2021) that the most helpful tools for learning are the educational technology used in schools, and students' preferences in using various multimedia tools. Similarly, the factors affecting modular distance learning were also identified. Some of the modular distance related factors were based on the Modified Learner Enrolment and Survey Form (2021) as to household capacity and access to distance learning. Similarly, Drăghicescu (2014) suggests that PBL involves three stages which include problem comprehension, curriculum exploring, and problem solving. When a teacher uses PBL in the classroom, he takes on the role of coach for his pupils, guiding them through the research process and capturing their interest in authentic and relevant learning.

In the development of the infographic learning material, the study considered Siricharoen and Siricharoen (2015) on three essential factors: visual, content and knowledge elements. This is on top of the findings of Siricharoen and Vinh (2016) that a highly valid PBL infographic learning material contains generally acceptable infographic design integration and problem-based learning stages integration.

As concluded by Basco (2020), the use of infographics in the teaching-learning process has been effective. Thus, it was suggested for utilization in science classes to enhance students' academic performance through intellectual development, life skills development and affective development. In addition, this study considers the PISA Draft Science Framework (2015) on the importance of scientific knowledge in learning the concepts of science prior to its application in skills. Thus, all three types of scientific knowledge are required for scientific literacy which are content knowledge, procedural knowledge and epistemic knowledge.

With these premises, this study applied all the principles in the development of the PBL through a researcher-made infographic material in modular distance learning. As the PBL has been proven to be an effective teaching strategy, it has not been incorporated in creating an infographic instructional material. Thus, this study fills this research gap.

3. Methodology

3.1 Research Design

The research employed a quantitative method that includes the descriptive and developmental designs by means of developing a problem-based infographic material and pre and post-test to check the effectiveness of the material in the teaching-learning process. Developmental research follows a systematic design through development and evaluation of instructional programs or materials, and evaluating changes over an extended period of time. On the other hand, descriptive design is a type of study in which data is gathered qualitatively and examined using quantitative methods. Surveys, interviews, correlation studies, observation studies, and content analysis are all used to collect data.

3.2 Participants of the Study

The participants of the study are thirty (30) randomly chosen Grade 7 students of a public high school in the San Pablo City, Laguna. Another set of participants include nine (9) experts who validated the infographic material.

3.3 Research Instrument

The study administered five (5) adapted survey questionnaires, teacher-made problem-based infographic material, and teacher-made pre-test and post-test questionnaires for scientific knowledge assessment. A survey questionnaire assessed the factors relating to modular distance learning as to household conditions that may impact the learners in terms of capacity, assistance to learners, gadgets available, internet access, connectivity sources, and learning challenges. The survey was adapted from Gueta and Janer (2021) and the Modified Learner Enrolment and Survey Form (2021). Multiple responses were required to some of the questions under this survey.

Another survey questionnaire in profiling the learners as to their multimedia preferences was adapted from Nicholas (2020) related to the various learning tools helpful for Generation Z learners, various teaching aids and preferred learning materials. Because they can provide a higher degree of dispersion and decrease neutral responses, 4-point Likert scales were employed to gauge the level of preference from highly preferred to not preferred (4 – highly preferred; 3 – preferred; 2 – seldom preferred; 1 – not preferred).

A survey questionnaire on the integration of the learning stages of PBL in the developed infographic material for the selected topics in Science 7 was also utilized. The survey was patterned from Drăghicescu (2014) with 14 statements generated to identify the integration of learning stages of PBL in terms of problem comprehension, curriculum exploring, and problem solving. Additionally, a survey questionnaire on the extent of integration of the infographic design elements to the developed PBL infographic material was utilized. This questionnaire was patterned from Siricharoen and Vinh (2016) with 41 statements to identify the incorporation of infographic design elements in terms of visual elements, content elements, and knowledge elements. A 4-point Likert scale was also employed to provide higher degree of dispersion and decrease neutral responses ranging from highly integrated to not integrated (4 – highly integrated; 3 – moderately integrated; 2 – slightly integrated; 1 – not integrated).

Lastly, a survey questionnaire for the student-respondents on their overall acceptability of the use of the PBL infographic material was utilized. The survey was adapted from Basco (2020) with 15 statements classified under the life skills, affective, and intellectual development of the learners upon utilizing the said infographic material. A 4-point Likert scales were also employed to gauge the level of acceptability from highly accepted to not acceptable (4 – highly acceptable; 3 – moderately acceptable; 2 – slightly acceptable; 1 – not acceptable).

A multiple-choice pre-test and post-test were used to measure the levels of scientific knowledge of the students in terms of content knowledge, procedural knowledge and epistemic knowledge. The test was adopted from the PISA 2015 Framework. A table of specifications was made to show the distribution of question items in both tests.

Prior to the actual data gathering, the instruments were subjected to external and internal validation to ensure validity and reliability. As to the scientific knowledge test, a reliability test during the pilot study was conducted to identify its level of reliability.

3.3 Research Procedure

Upon approval from concerned individuals and offices, a consent form was disseminated to the students and parents before handing out the survey questionnaires on Modular Distance Related Factors and Multimedia Preference, and the conduct of Pre-Test. The coverage of the utilization of the problem-based infographic material were three consecutive weeks with topics such as Sound, Light, and Heat based on the Budget of Work (BOW). After the 3-week period, the post-test was administered to assess the impact of the use of problem-based infographic material to the respondents' scientific knowledge. Likewise, a survey questionnaire was given.

3.4 Statistical Treatment of Data

The study used both descriptive and inferential statistics. Descriptive measures such as mean and standard deviation were applied to describe the perception of the respondents as to the material and performance of the respondents in terms of their scientific knowledge. For the inferential statistics, Pearson Moment Product Correlation was utilized to find significant relationship among variables. Paired t-test was employed to determine if there is a significant difference between the pre-test and post-test scores of the students as exposed to problem-based infographic material. All inferential statistics were tested at 5% level of confidence.

4. Findings and Discussion

Table 1 shows the summary of the expert respondents' perception on the extent of integration of the problem-based learning stages. Generally, the stages of problem-based learning were incorporated and is highly integrated except for problem solving being moderately integrated (M = 3.49, SD = 0.51), with an overall mean value of 3.62 (SD = 0.43) which is highly integrated.

Table 1

Extent of Integration of the Stages of Problem-Based Learning

Stages	Mean	Standard Deviation	Verbal Interpretation
Problem Comprehension	3.73	0.33	Highly Integrated
Curriculum Exploring	3.63	0.51	Highly Integrated
Problem Solving	3.49	0.51	Moderately Integrated
Overall	**3.62**	**0.43**	**Highly Integrated**

Legend: 3.50-4.00 Highly Integrated (HI); 2.50-3.49 Moderately Integrated (MI); 1.50-2.49 Slightly Integrated (SI); 1.00-1.49 Not Integrated (NI)

Table 2 summarizes the extent of the integration of visual elements in terms of design style, color and size, icons, and diagrams and charts. An overall high integration level (M = 3.61, SD = 0.36) was evident in all visual elements except for diagrams and charts being moderately integrated (M =3.33, SD = 0.50).

Table 2

Extent of Integration of Infographic Design Visual Elements

Elements	**Mean**	**Standard Deviation**	**Verbal Interpretation**
Design Style	3.75	0.33	Highly Integrated
Color and Size	3.69	0.43	Highly Integrated
Icons	3.67	0.50	Highly Integrated
Diagrams and Charts	3.33	0.50	Moderately Integrated
Visual Elements	**3.61**	**0.36**	**Highly Integrated**

Legend: 3.50-4.00 Highly Integrated (HI); 2.50-3.49 Moderately Integrated (MI); 1.50-2.49 Slightly Integrated (SI); 1.00-1.49 Not Integrated (NI)

The result suggests the importance to focus on the content so that the infographic material will be of great help for learners to understand the topic easily. In addition, color and size and the icons to be used in creating a learning material like infographic should also be considered so that the material can attract the readers and serve its purpose to where it is intended. Utilizing diagrams and charts should also be considered to offer an exceptional learning material for the students. The use of this visual element may present data in a comprehensible manner that will easily help the students identify information. Infographics are made up of a variety of visual elements with different looks, such as icons, photos, decorations, and text. Graphic designers who are skilled at what they do usually execute it with an aesthetic and creative mindset, infusing them with personality and style (Lu, 2020). Several activities must be taken during the construction of infographics' visual content in order to maximize the efficiency of the visualization process.

Table 3

Extent of Integration of Infographic Design Content Elements

Elements	Mean	Standard Deviation	Verbal Interpretation
Data	3.87	0.28	Highly Integrated
Story and flow	3.67	0.33	Highly Integrated
Words	3.78	0.34	Highly Integrated
Content Elements	**3.77**	**0.30**	**Highly Integrated**

Legend: 3.50-4.00 Highly Integrated (HI); 2.50-3.49 Moderately Integrated (MI); 1.50-2.49 Slightly Integrated (SI); 1.00-1.49 Not Integrated (NI)

Table 3 summarizes the extent of integration of infographic design elements in the developed infographic material as to content elements. All elements were highly integrated with a mean value of 3.77 (SD = 0.30). Data, story and flow, and words were evidently incorporated in the developed infographic material.

The items included in the infographic were focused on the inclusion of facts, statistics, texts, references, time frames, and others. Considering these elements to produce quality infographic material may result to an effective learning material which can later on be utilized by learners and can cover other topics of other subject areas. Similar to the findings of Parveen and Husain (2021), students are more likely to read the facts, understand the data, and draw conclusions more quickly and thoroughly when they are motivated to do so.

Table 4 summarizes the extent of integration of infographic design elements in the developed infographic material as to knowledge element. Both indicators, sources and publishers, were highly integrated in the material (M = 3.69, SD = 0.39).

Table 4

Extent of Integration of Infographic Design Knowledge Elements

Element	Mean	Standard Deviation	Verbal Interpretation
Sources	3.83	0.22	Highly Integrated
Publishers	3.56	0.57	Highly Integrated
Knowledge Element	**3.69**	**0.39**	**Highly Integrated**

Legend: 3.50-4.00 Highly Integrated (HI); 2.50-3.49 Moderately Integrated (MI); 1.50-2.49 Slightly Integrated (SI); 1.00-1.49 Not Integrated (NI)

The information gathered to create the infographic material came from reliable sources in order to provide factual and quality content. It is very important to identify sources that are reliable in order to harvest data that is factual since it will be incorporated as a tool for learning. People this age actively choose, accept, and share information, and that personal judgment played a significant role in this process (Won, 2018).

Table 5

Acceptability of the PBL Infographic Material

Elements	Mean	Standard Deviation	Verbal Interpretation
Intellectual Development	3.38	0.44	Moderately Acceptable
Life Skills Development	3.41	0.52	Moderately Acceptable
Affective Development	3.43	0.50	Moderately Acceptable
Overall Acceptability	**3.41**	**0.43**	**Moderately Acceptable**

Legend: 3.50-4.00 Highly Acceptable (HA); 2.50-3.49 Moderately Acceptable (MA); 1.50-2.49 Slightly Acceptable (SA); 1.00-1.49 Not Acceptable (NA)

Table 5 summarizes the student respondents' perception on the overall acceptability of the developed problem-based infographic material as to the skills they need to develop. Generally, all skills presented obtained moderately acceptable level (M = 3.41, SD = 0.43). It is evident that the affective aspect of the learner was developed (M = 3.43, SD = 0.50) since it provided opportunities for learners to engage into learning without them getting bored and enhance their ability to be creative. Intellectual development (M = 3.38, SD = 0.44) and life skills development (M = 3.41, SD = 0.52) were also an important aspect to be enhanced to achieve holistic education. Not only it will advance the cognitive abilities of the learner but also through the help of infographics, it will increase their creativity and fact-finding abilities.

Infographics can be considered alternative educational tools that may provide solutions for educators who teach abstract or complicated subjects that are difficult to express verbally. The findings support the claims of Alrwele (2017) that infographics may offer significant educational potential for improving learners' life skills, intellectual, and affective qualities. Similarly, it has been found to be beneficial in improving student achievement in learning lectures and courses.

Table 6

Test of Difference in the Level of Scientific Knowledge Before and After the Use of PBL Infographic Material

	Pretest		Posttest		t	df	Sig. (2-tailed)	Interpretation
	M	SD	M	SD				
Content Knowledge	6.467	3.3398	7.93	3.423	- 4.253	29	0.000	Significant
Procedural Knowledge	4.967	2.5118	6.73	2.677	- 4.851	29	0.000	Significant
Epistemic Knowledge	4.000	2.2438	5.67	2.695	- 3.953	29	0.000	Significant
Total Score	15.500	6.7607	20.33	7.284	- 7.293	29	0.000	Significant

Legend: Sig. (2 – tailed) > 0.05, Not Significant
Sig. (2 – tailed) < 0.05, Significant

Table 6 presents the test of difference in the level of scientific knowledge of the students before and after the use of the PBL infographic material. It can be observed that there is a significant difference between the pretest and posttest results of the respondents and their level of scientific knowledge as to content knowledge, procedural knowledge, and epistemic knowledge. For each topic, it consisted of 15-items questions, and for every 5 questions it measures the content, procedural, and epistemic knowledge of the learners.

These findings imply that after using the problem-based infographic material, the students were able to enhance their content knowledge, procedural knowledge, and epistemic knowledge. As a result, it was presumed that students have a basic understanding of the major scientific explanatory concepts and ideas that were included in the material distributed to them. In terms of measuring procedural knowledge, the test items were focused on understanding of techniques used by scientists to arrive at scientific conclusions. Lastly, it is evident that the epistemic knowledge of the students was enhanced. Test items were focused on grasping of justification for typical scientific inquiry procedures, the status of assertions created, and the meaning of key words like theory, hypothesis, and data. It involved the analysis regarding various scientific concepts and theory like the occurrence of explosion in space, will there be sound produced, and others.

Table 7

Relationship between the Acceptability of the PBL Infographic Material and Level of Scientific Knowledge

Perceived acceptability	Level of Scientific Knowledge Posttest			
	Total	Content	Procedural	Epistemic
Intellectual	0.037	-0.172	-0.026	0.344
Life skill	0.121	0.003	0.066	0.259
Affective	-0.050	-0.196	-0.150	0.262
Overall Acceptability	**0.043**	**-0.134**	**-0.040**	**0.326**

Table 7 shows the test of relationship between the perceived level of acceptability of the PBL infographic material and the posttest scores of the respondents as to their level of scientific knowledge. It can be observed that there is a positive correlation between the content knowledge and procedural knowledge when it comes to the life skill development of the learners. This means that as the level of scientific knowledge of the learners increases after using the problem-based infographic material, the life skill development also increases.

In terms of the epistemic knowledge, it obtained a positive correlation in all skills developed – intellectual, life skills, and affective. This means that the learners can justify typical scientific inquiry procedures, identify and give meaning to key words presented in theory, hypothesis, and data. However, there are negative correlation values obtained in content knowledge and procedural knowledge in terms of the intellectual and affective development of the learners. A negative correlation value implies that the variables move in opposite direction.

This is in contrast to the study of Basco (2020) that infographics had a considerable impact on students' intellectual development. In terms of the development of life skills, infographics strengthen the cognitive domain and help people develop life skills like communication and teamwork. In order to effectively relate and work with people in the twenty-first century learning environment, several abilities are required. Lastly, in terms of affective development, it indicates that infographics should be used in class to increase motivation and self-confidence.

5. Conclusion

The study sought to develop a problem-based infographic material to enhance the scientific knowledge of Grade 7 modular distance learners during the School Year 2021-2022. The study used descriptive-developmental research design focused on experts' perception on the integration of problem-based learning stages and infographic design elements and the students' perception on the overall acceptability of the infographic material to advance their scientific knowledge.

From the data gathered and interpreted, expert respondents perceived that the PBL learning stages and the infographic design elements were highly integrated in the developed problem-based infographic material. In addition, the students found that the intellectual, life skills, and affective aspects of the infographic material were moderately acceptable. Furthermore, there was an increase in the posttest scores compared to the pretest scores after utilizing the PBL infographic material. There was a significant difference on the level of scientific knowledge of the students before and after using the developed PBL material. Significant relationships were found in the epistemic knowledge and the acceptability of the infographic material as to intellectual, life skills, and affective development. However, a not significant relationship was found between content and procedural knowledge and the intellectual and affective aspect of the acceptability of the material. Therefore, there is no significant relationship in the overall acceptability of the problem-based infographic material and the level of scientific knowledge of the respondents.

Based on the findings of the study, it is concluded that the use of an infographic material increases the level of scientific knowledge of the students given that all elements were fully and highly integrated to create a quality learning material. It is effective in developing the said skills for the learners.

References

Alrwele, N. S. (2017, September). Effects of Infographics on Student Achievement and Students' Perceptions of the Impacts of Infographics. *Journal of Education and Human Development, 6*(3), 104-117. doi: 10.15640/jehd.v6n3a12

Barnes & Noble College. (2016). Getting to know Gen Z: Exploring middle and high schoolers' expectations for higher education. Retrieved from https://www.bncollege.com/wp-content/uploads/2018/09/Gen-Z-Report.pdf

Basco, R. O. (2020). Effectiveness Of Science Infographics In Improving Academic Performance Among Sixth Grade Pupils Of One Laboratory School In The Philippines. *Research in Pedagogy, 10*(2), 313-323. doi:10.5937/IstrPed2002313B

Chamsai, P., & Chanchusakun, S. (2020). The Effects of the Problem-Based Learning with Infographics on the Mathematical Communication Ability of Fourth Grade Students. *12*(2).

Drăghicescu, L. M. (2014). Application of Problem-Based Learning Strategy in Science lessons - Examples of Good Practice. *Procedia - Social and Behavioral Sciences*, 297 – 301. doi:10.1016/j.sbspro.2014.08.245

Edith Cowan University. (n.d.). Retrieved January 19, 2022, from https://intranet.ecu.edu.au/learning/curriculum-design/teaching-strategies/problem-based-learning

Gallicano, T. D., Ekachai, D. G., & Freberg, K. (2014). The infographics assignment: A qualitative study of students' and professionals' perspectives. *Public Relations Journal, 8*(4).

Gormally, C. (2012). Developing a Test of Scientific Literacy Skills (TOSLS): Measuring Undergraduates' Evaluation of Scientific Information and Arguments. *CBE—Life Sciences Education*, 364-377. doi:10.1187/cbe.12-03-0026

Gueta, M. F., & Janer, S. S. (2021). Distance Learning Challenges on the Use of Self-Learning Module. *United Internation Journal for Research and Technology (UIJRT), 2*(7). doi:i7/UIJRTV2I70010

Jufrida, J. (2019, December). Scientific literacy and science learning achievement at junior high school. *International Journal of Evaluation and Research in Education (IJERE), 8*(4), 630~636. doi:10.11591/ijere.v8i4.20312

K to 12 Curriculum Guide for Science. (2016).

Lu, M. (2020, April). Exploring Visual Information Flows in Infographics. *ACM*. doi:https://doi.org/10.1145/3313831.3376263

Mayer, R. E. (2014). Cognitive theory of multimedia learning. In R. E. Mayer, *The Cambridge handbook of multimedia learning* (pp. 43-71). Cambridge University Press. doi:https://doi.org/10.1017/CBO9781139547369.005

MLESF. (2021). *Modified Learner Enrolment and Survey Form.*

Nassaji, H. (2015). Qualitative and descriptive research: Data type versus data analysis. *Language Teaching Research, 19*(2).

Nicholas, A. J. (2020, January 1). Preferred Learning Methods of Generation Z. *Digital Commos @ Salve Regina University*. Retrieved from https://digitalcommons.salve.edu/fac_staff_pub

Overton, T. (2016). Context and Problem-based Learning. *New Directions in the Teaching of Physical Sciences*. doi:10.29311/ndtps.v0i3.409

Ozdamli, F., & Ozdal, H. (2017, December 19). Developing an Instructional Design for the Design of Infographics and the Evaluation of Infographic Usage in Teaching Based on Teacher and Student Opinions. *EURASIA Journal of Mathematics, Science and Technology Education, 4*(4), 1197-1219. doi:https://doi.org/10.29333/ejmste/81868

Parveen, A., & Husain, N. (2021, August). Infographics As A Promising Tool For Teaching And Learning. *Journal of Emerging Technologies and Innovative Research (JETIR), 8*(8). Retrieved from https://www.jetir.org/papers/JETIR2108322.pdf

PISA. (2015). PISA 2015 Draft Science Framework. Retrieved January 19, 2022

PISA. (2018). *PISA 2018 Assessment and Analytical Framework.*

Silva, A. B. (2018, April 20). Problem-based learning: A proposal for structuring PBL and its implications for learning among students in an undergraduate management degree program. *Revista de Gestão, 25*(2), 160-177. doi:https://doi.org/10.1108/REGE-03-2018-030

Simbulan, N. P. (2020). *The Philippines – COVID-19 and Its Impact on Higher Education in the Philippines.* The Head Foundation. Retrieved from https://headfoundation.org/2020/06/04/covid-19-and-its-impact-on-higher-education-in-the-philippines/

Siricharoen, W. V., & Siricharoen, N. (2015, May). How Infographic Should Be Evaluated? *ICIT 2015 The 7th International Conference on Information Technology*. doi:10.15849/icit.2015.0100

Siricharoen, W. V., & Vinh, P. C. (2016). Question matrix method according to divided dimensions of infographics evaluation. *Personal and Ubiquitous Computing, 21*(2), 219-233. doi:10.1007/s00779-016-0988-7

Wicaksono, R. S. (2019). Implementation of Problem Based Learning Combined With Think Pair Share In Enhancing Students' Scientific Literacy and Communication Skill Through Teaching Biology in English Course Peerteaching. *Journal of Physics: Conference Series*. doi:10.1088/1742-6596/1227/1/012005

Won, J. (2018). Interactive Infographics and Delivery of Information: The Value Assessment of Infographics and Their Relation to User Response. *Archives of Design Research, 31*(1), 57-69. doi: https://doi.org/10.15187/adr.2018.02.31.1.57